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ABSTRACT

This document reports on a survey that was conducted to determine the extent to which a random sample (N=2,112) of Maine public school teachers (K-12) included marine-related topics or activities in their teaching, as well as how informed they were about existing marine education curricula. A total of 588 questionnaires were returned. Findings indicate that the: (1) amount of time spent on marine education; (2) number of marine topics taught; and (3) proportion of teachers who taught marine topics all decreased as distance from the coast increased. These trends were attributed to the level of accessibility to the ocean environment and to local cultural factors and priorities. Recommendations for further research in several areas relating to marine education in general, as well as specifically in Maine, are presented. The survey instrument is included. (TW)

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MARINE-RELATED EDUCATION IN MAINE:

A SURVEY OF K-12 PUBLIC SCHOOL TEACHERS

By

Michael Brody, Helmut Koch and Warren Tomkiewicz

College of Education, University of Maine, Orono, Maine
04469

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INTRODUCTION

According to a statement made in 1977 by Dr. Gilven Slonim (Slonim, 1977), president of the Oceanic Education Foundation at that time, "...The United States' future will be inextricably tied to the oceanic world. How well the nation rises to this challenge of the sea will depend ultimately on the enlightenment, the determination and the direction of its policy drive, and this is a function of how well its people understand the sea....The United States must invest its energies and ingenuity, as well as additional educative resources, in multi-cultural, multi-disciplinary oceanic education to sharpen its citizens' understanding of the world oceans. Once knowing their profound stake in the sea, their new knowledge will enrich their sense of the future destiny of this nation, which manifestly remains oceanic". This statement is as true today as it was 10 years ago.

The nation's schools share the primary responsibility of educating America's youth about the marine environment--the bio-physical interrelationships that account for a balanced marine ecosystem, the present and future use and management of marine resources, the social, political and economic impacts of management decisions, and the overall decision-making processes that will ensure the continued health and productivity of the seas. According to Fortner and Teates (1980), vast as the oceans are relative to other environments, they have received a disproportionately low level of attention in formal education. Occasionally, science teachers include marine units or lessons in their biology or earth science classes, and elective courses in marine biology and oceanography appear to be fairly common in secondary schools. But as Fortner and Teates point out "marine education connotes a more comprehensive awareness--one which considers all facets of the oceanic environment and its influence on human affairs. Few students are led to appreciate the ocean's role in human culture such as the arts, literature, language and political affairs. The educational process as a whole has frequently ignored or passed lightly over our maritime heritage and its contributions to the nation's development" (1980, p.12).

The significant role of the marine environment in the socio-economic past, present and future of the state of Maine can hardly be overstated. The high species productivity of the Gulf of Maine, the international disputes over renewable and non-renewable resource exploitation in the Gulf and the scenic appeal of Maine's coastline all have the potential of creating intense pressures on offshore and coastal environments. Ultimately, these pressures can only be relieved by sound and mutually agreed upon conservation practices, requiring a citizenry knowledgeable about basic principles of marine ecosystem structure and processes, and about the social, economic and political impact of the marine environment on its welfare. According to the University of Maine-University of New Hampshire Sea Grant College Program, "the issues affecting Maine's seacoast are major public policy issues requiring the understanding and support of <u>all</u> Maine citizens and their elected representatives" (1986, p.12).

A recent study by Brody and Koch (1985) revealed that Maine public school students in 4th, 8th and 11th grade generally have a low level of knowledge and understanding about the marine environment and its relationship to their state's cultural history and future. Without such basic knowledge and understanding, it is difficult to envision these

students making intelligent, informed future decisions about critical marine-related issues that might affect their lives. The next step is to ask: "What are Maine's teachers doing to enhance their students' knowledge, understanding and awareness of the marine enviroment?" This survey study was designed to answer certain aspects of that question.

The overall purpose of this survey was to determine the extent to which a random sample of Maine public school teachers (K-12) include marine-related topics or activities in their teaching, and how informed they are about existing marine education curricula. A random sample of all Maine public school teachers was chosen, rather than a sample of teachers from a single discipline, based on the philosophy that concepts, issues and activities related to the marine environment are essentially inter and multi-disciplinary and can be included in most general school subject areas at any grade level. The specific questions that were addressed by this survey are:

(1) How much time during the school year do teachers devote to marine education topics/activities in their classes, and how is this related to the county in which the teacher teaches and to the distance of the teacher's school from the coast?

(2) How many students do teachers involve in marine education topics/activities during a school year, and how is this related to county and distance from the coast?

(3) What are the general school subjects areas into which teachers who teach marine education topics/activities most and least frequently incorporate such topics/activites?

(4) What is the frequency (in terms of % teachers) with which various specific marine topics are taught, what is the average number of marine topics taught, and how is this related to county and distance from the coast?

(5) What is the frequency of teachers who are familiar with or who have used various existing marine education curricula, and how is this related to the county in which the teachers teach?

(6) How useful do teachers find various existing marine education curricula?

(7) Within the sub-population of teachers who teach marine topics/activities, are there differences between grade levels with respect to (a) amount of time devoted to marine topics/activities, (b) number of students involved in or exposed to marine topics/activities, (c) frequency of teachers teaching marine topics/activities, (d) frequency of teachers teaching various specific marine topics, and number of these topics taught, (e) frequency of teachers familiar with or having used various marine education curricula, and (f) usefulness ratings of various marine education curricula?

METHODS

A one page, 9-item questionnaire (Appendix 1) addressing the various research questions in this study was prepared by the authors during October, 1985. In November,1985, a list of 10% of 1984-85 full-time public school teachers in each Maine school district was generated randomly by computer at the Maine Department of Educational and Cultural Services. This yielded a total sample of 2,112 teachers. Survey questionnaires and letters of transmittal were mailed to these teachers in the middle of November, 1985. Ninety percent of the final number of mail-backs were received by early February, 1986, although a few were received as late as April, 1986. Follow-up of non-respondents was not possible since the survey instrument did not ask for name and address, to assure confidentiality. In any event, time and other resource limitations would not have permitted extensive follow-up procedures.

Questionnaire data were entered into the mainframe computer at the University of Maine (Orono) between February and April, 1986, and were analyzed with the SPSSX statistical package during the summer of 1986.

RESULTS

Five hundred and sixty-eight (568) of the 2,112 questionnaires were returned, representing a mail-back rate of 26.9%. This is a fairly low response rate, increasing the chances of sampling biases. In their written comments, numerous respondents stated that the questionnaire was not applicable to their teaching situation, which they perceived to be unrelated to marine education. It is possible, therefore, that the non-respondent group was biased towards teachers who perceived their current teaching assignment to be unrelated to marine education, and who consequently may have felt that their responses to the survey would not contribute any significant information. Also, numerous respondents indicated that, although they realized the importance of marine education for the state of Maine, they had not made strong enough efforts to incorporate marine topics into their teaching. It is possible that some members of the non-respondent group did not respond for this reason. If these assumptions about the non-respondent group are valid, the responding sample of teachers may have been biased towards teachers who use marine education topics or activities in their teaching or who make a reasonable effort to do so. Generalization of some of the survey results to the target population of all Maine public school teachers must, therefore, be made cautiously. Whenever appropriate, separate analyses were done on the total number of respondents and on respondents who indicated teaching marine-related topics to their classes. Consequently, if overall sampling biases existed, we may at least have a fairly accurate account of what is being done by those teachers who teach marine-related topics/activities in their classrooms.

General Demographic Data

Table 1 gives the number of towns in each county from which survey responses were received, and the percentage this represents in terms of the total number of towns from which replies were received (N=196). The majority of towns (55.9%) from which replies were received came from five counties--Penobscot, Aroostook, Cumberland, Kennebec and York.

Table 2 shows the number and percent of total survey replies received from each county. Returns from 4 counties--Cumberland, Penobscot, Kennebec and York--made up 51.7% of the total mail-back sample.

Table 3 shows the number and percent of respondents whose schools are located various distances from the Maine coast. Nearly one-third of the respondents (31.2%) teach in schools located within 10 miles of the coast, and almost two-thirds (63.9%) teach in schools located within 50 miles of the coast.

Time Devoted to Marine Education

Tables 4-11 present data on the amount of time during the school year responding teachers indicated spending on marine education topics or activities in their classes. This time factor was analyzed in relation to grade level, distance of teacher's school from the coast, and county.

Table 4 shows the number and percent of responding teachers who indicated spending various amounts of time on marine education

Table 1 Number of towns, by county, from which teacher replies were obtained. (Town is location of teacher's school)

County	Number of towns from which replies were obtained	% of total number of towns from which replies were obtained (N=196)	Cumulative %
Penobscot	25	12.8	12.8
Aroostook	23	11.7	24.5
Cumberland	21	10.7	35.2
Kennebec	20	10.2	45.7
York	20	10.2	55.9
Oxford	14	7.1	63.0
Hancock	12	6.1	69.1
Washington	10	5.1	74.2
Somerset	9	4.6	78.6
Androscoggin	8	4.1	82.7
Franklin	8	4.1	86.8
Knox	7	3.6	90.4
Waldo	7	3.6	94.0
Lincoln	4	2.0	96.0
Piscataquis	4	2.0	98.0
Sagadahoc	4	2.0	100.0

Table 2 Number and percent of teachers who responded to survey, by county (one respondent did not indicate town and county).

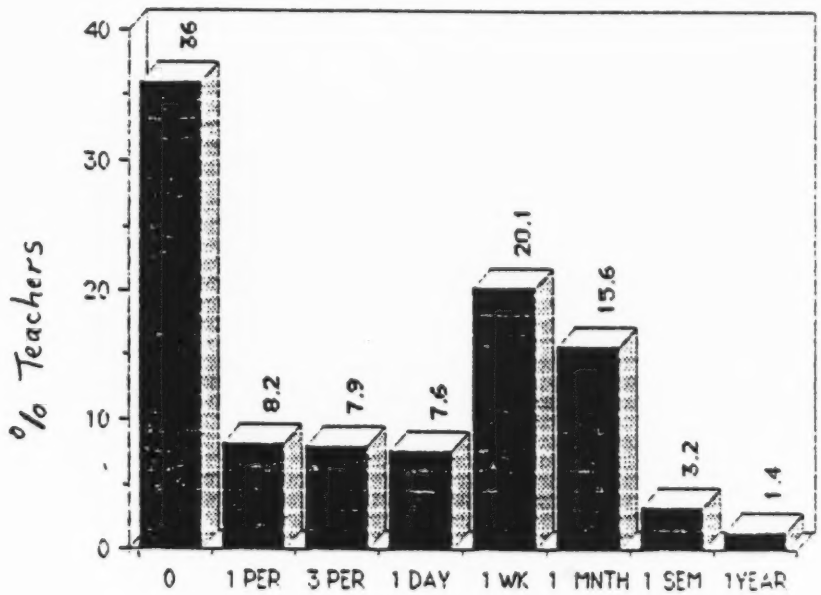
County	Number of Teachers	% of respondents (N=567)	Cumulative %
Cumberland	93	16.4	16.4
Penobscot	71	12.5	28.9
Kennebec	65	11.5	40.4
York	64	11.3	51.7
Aroostook	62	10.9	62.6
Androscoggin	34	6.0	68.6
Somerset	32	5.6	74.2
Hancock	23	4.1	78.3
Oxford	21	3.7	82.0
Franklin	20	3.5	85.5
Waldo	18	3.2	88.7
Washington	18	3.2	91.9
Knox	16	2.8	94.7
Sagadahoc	14	2.5	97.2
Piscataquis	10	1.7	98.9
Lincoln	6	1.1	100.0

Table 3 Number and % of responding teachers teaching in schools located various distances from the coast.

Distance of school from coast (miles)	Number of Teachers	% of respondents (N=567)	Cumulative %
0 - 10	179	31.6	31.6
11 - 50	183	32.3	63.9
51 - 100	117	20.6	84.5
> 100	88	15.5	100.0

Table 4 Number and percent of responding teachers who reported spending various amounts of time during the school year on marine-related activities and topics (12 teachers did not specify time).

Time on marine-related activities/topics during school year	Number of Teachers	% of respondents (N=556)	Cumulative %
0	200	36.0	36.0
1 Period	45	8.2	44.7
3 Periods	44	7.9	52.1
1 Day	42	7.6	59.7
1 Week	112	20.1	79.8
1 Month	87	15.6	95.4
1 Semester	18	3.2	98.6
1 Year	8	1.4	100.0



topics/activities in their classes. Sixty-four (64) percent of the respondents indicated spending at least 1 class period during the year on marine education. The majority of respondents (59.7%) indicated spending zero time to 1 day on marine-related topics/activities, with 36% indicating that they spend no time on marine education.

Table 5 is a time-breakdown of the teachers who spend at least 1 class period during the year on marine-related topics. Of these teachers, over two-thirds (68.3%) devote anywhere from 1 class period to one week to marine education. The two most frequent times reported by these teachers were 1 week (31.5%) and 1 month (24.4%).

Table 6 gives a time-breakdown according to grade level, including only those teachers who indicated spending at least 1 class period during the year on marine education. No striking differences are apparent between the various grade levels, with one week representing the most frequent response. These frequency data are supported by the results of a one-way analysis of variance and Duncan's multiple range test for differences between means. The analyses showed no significant differences in the amount of time spent on marine education by teachers at the various grade levels (.05 level of significance). The means ranged from 12 days at the 10th grade level to 27 days at the 5th grade level, but the variability within grade levels was substantial.The correlation between grade level and time devoted to marine education was insignificant ($r=-0.04$; $p=0.20$). It must be re-emphasized that these results are based only on those respondents who indicated teaching marine education topics for at least 1 class period during the school year. Our survey instrument (item #9, Appendix 1) asked for grade level only if the teacher was using or covering marine-related topics in his/her classes. Thus, we have no data on the amount of time devoted to marine education by grade level including <u>all</u> responding teachers at each grade level. The conclusion which emerges from our results is that, in the population of teachers who spend time on marine-related topics/activites, there are no significant differences between grade levels in the amount of time devoted to such topics/activities.

Table 7 shows a breakdown of the percent of responding teachers who reported teaching marine education for various amounts of time, according to distance of the teacher's school from the coast. The overall pattern suggests that as distance from the coast increases, the percentage of teachers who devote time to marine education declines. This is supported by the correlation between time spent on marine education and distance from the coast, shown in Table 8. The correlation was -0.19 when all respondents were included in the analysis, and -0.20 when only those teachers who reported teaching at least 1 class period per year of marine education topics were used in the analysis. Although both correlation coefficients are significantly different from zero, the relationship is weak, with distance from the coast explaining only about 3.8 to 4.0% (r^2) of the variance in the amount of time teachers devote to marine education. As would be expected, there are many factors besides distance from the coast that influence the amount of time a teacher might devote to marine education topics. Nevertheless, it seems reasonable that coastal schools would tend to spend more time on marine-related topics in view of the greater accessibility to the ocean and, possibly, a significant proportion of the school's community being involved in marine-related occupations.

Table 5 For the sub-population of respondents who indicated teaching marine education topics, number and % who spent various amounts of time on marine topics during the school year.

Time devoted to marine education/year	Number of Teachers	% of respondents (N=356)	Cumulative %
1 Period	45	12.6	12.6
3 Periods	44	12.4	25.0
1 Day	42	11.8	36.8
1 Week	112	31.5	68.3
1 Month	87	24.4	92.7
1 Semester	18	5.1	97.8
1 Year	8	2.2	100.0

Table 6 Frequency with which teachers at various grade levels reported spending various amounts of time on marine-related topics or activities. Data are % teachers. Only those teachers who reported spending 1 period or more per year on marine topics are included in the analysis.
N=number of teachers *=most frequent responses

		Time spent on marine-related topics/year						
Grade	N	1 Period	3 Periods	1 Day	1 Week	1 Month	1 Semester	1 Year
K	38	13.2	7.9	10.5	39.5*	21.1*	0	7.9
1	44	22.7*	6.8	6.8	36.4*	18.2	2.3	6.8
2	45	8.9	6.7	11.1	31.1*	33.3*	2.2	6.7
3	51	17.6	11.8	9.8	31.4*	23.5*	2.0	3.9
4	57	10.5	8.8	3.5	35.1	29.8*	7.0	5.3
5	46	10.9	15.2	4.3	28.3*	23.9*	10.9	6.5
6	47	10.6	19.1	10.6	21.3*	23.4*	12.8	2.1
7	43	9.3	16.3	9.3	30.2*	23.3*	7.0	4.7
8	33	15.2	18.2	9.1	27.3*	21.2*	3.0	6.1
9	31	9.7	12.9	19.4	22.6*	22.6*	12.9	0
10	40	7.5	22.5*	15.0	25.0*	20.0	7.5	0
11	38	13.2	13.2	23.7*	21.1*	15.8	7.9	2.6
12	38	10.5	15.8	26.3*	18.4*	15.8	10.5	2.6

Table 7 Percent of teachers spending various amounts of time on marine-related topics in their classes, in relation to distance of teacher's school from the coast. N=number of teachers

Time spent on marine topics/activities per year	Miles from Coast 0-10 (N=175)	11-50 (N=178)	51-100 (N=115)	>100 (N=87)
0	25.7	39.3	35.7	50.6
1 Period - 1 Day	21.2	25.8	26.1	20.6
1 Week	20.0	21.3	22.6	14.9
1 Month	22.3	11.8	13.0	12.6
1 Semester	6.9	1.1	2.6	1.1
1 Year	4.0	0.6	0.0	0.0

Table 8 Correlation between miles of teachers' schools from the coast and amount of time spent on marine activities/topics.

	Miles from coast	N	P
Time[1]	r= - 0.19	555	< .001
Time[2]	r= - 0.20	355	< .001

1 = all teachers
2 = teachers who indicated spending 1 class period or more on marine education

Table 9 shows the mean number of days per year devoted to marine education, in relation to the distance of the teachers' schools from the coast. When all respondents were included in the analysis, the mean number of days spent on marine education by teachers teaching within 10 miles of the coast (18.5 days) was significantly higher than the mean number of days spent on marine education by teachers teaching in schools located 11-50, 51-100 and >100 miles from the coast (ANOVA, Duncan's multiple range test; $p<0.05$). There was no signficant difference in time devoted to marine education between teachers teaching in schools located 11-50, 51-100 and >100 miles from the coast. A similar pattern was observed when only those teachers who indicated devoting at least 1 class period/year to marine education were included in the analysis (that is, exclusion of teachers who indicated devoting zero time to marine-related topics). Thus, of those teachers who indicated spending time on marine education, those teaching within 10 miles of the coast devote significantly more time to marine education (mean = 25.0 days) than those teaching in schools further from the coast. Table 9 also shows that the mean number of days spent on marine-related topics/activities by all respondents was 9.6 days, compared to 15.0 days for those respondents who teach marine education topics for at least 1 class period/year.

Table 10 shows the percentage of teachers in each county who indicated teaching marine education topics/activities for various amounts of time during the school year. At least sixty-five percent (65%) of the respondents from 11 out of the 16 counties indicated spending at least some time (1 class period or more) on marine education. These counties are: Somerset, Washington, Hancock, Franklin, Waldo, Kennebec, Lincoln, Knox, Sagadahoc, Cumberland and York. With the exception of Somerset and Franklin, all of these counties have coastal stretches, and all counties with coastal stretches are on this list. Counties in which 50% or more of the respondents indicated devoting at least 1 week to marine-related topics include: Washington, Hancock, Franklin, Waldo, Lincoln, Knox and York. With the exception of Franklin, all of these counties are coastal.

Table 11 gives the mean number of days spent on marine topics by responding teachers in each county. The means in column A are based on all respondents from each county, whereas the means in column B are based only on those teachers who indicated spending some time (at least 1 class period/year) on marine education topics. Analysis of variance followed by Duncan's multiple range test revealed significant differences ($p<0.05$) between the following counties, based on all respondents from each county (column A): (1) Lincoln was significanly higher than all other counties, (2) Knox was significantly higher than all the other counties except Washington, Hancock and Sagadahoc (and, of course, Lincoln), (3) Washington was significantly higher than Cumberland, Somerset, Androscoggin, Penobscot, Oxford, Kennebec and Aroostook, and (4) York was significantly higher than Penobscot, Kennebec and Aroostook. It should be noted that significant differences are not merely based on the absolute difference between means but also on the variability about the means and on the number of respondents on which the mean is based. The fact that Hancock was not significantly higher than any of the counties with lower means while York, with a lower mean than Hancock, was significantly higher than some of the counties with lower means reflects the larger number of respondents from York compared to Hancock (see Table 2). A similar analysis of the data in column B, including

Table 9 Mean time (number of days) teachers indicated devoting to marine education, by miles from coast.

Miles from Coast	Mean number of days ± SD spent on marine education, based on all respondents in each distance category	Mean number of days ± SD spent on marine education, excluding teachers who indicated zero time
0 - 10	18.5 ± 38.8	25.0 ± 43.2
11 - 50	5.5 ± 16.8	9.1 ± 20.8
51 - 100	6.1 ± 14.8	9.6 ± 17.6
> 100	4.4 ± 11.1	8.9 ± 14.6
Grand Mean	9.6 ± 25.7	15.0 ± 30.9

Table 10 Percent of teachers in each county reporting various amounts of time (per year) spent on marine topics/activities in their classrooms. Numbers in parentheses are number of teachers.

Time spent on marine topics/ activities per year	Aroost. (61)	Somer. (31)	Piscat. (10)	Penob. (70)	Wash. (18)	Han. (22)	Frank. (20)	Oxford (21)	Waldo (18)	Kenne. (63)	Linc. (6)	Knox (16)	Sagad. (14)	Cumber. (89)	York (64)	Andro. (32)
0	50.8	29.0	60.0	45.7	11.1	31.8	35.0	38.1	16.7	31.7	16.7	12.5	28.6	33.7	35.9	46.9
1 class period to 1 day	21.3	25.8	20.0	27.1	33.4	18.2	15.0	28.6	11.2	27.0	16.7	25.1	35.7	25.8	14.1	25.1
1 week	14.8	29.0	10.0	15.7	27.8	18.2	20.0	14.3	44.4	31.7	0	6.3	28.6	20.2	18.8	9.4
1 month	13.1	12.9	10.0	8.6	16.7	18.2	25.0	19.0	27.8	9.5	16.7	37.5	0	15.7	23.4	15.6
1 semester	0	3.2	0	2.9	0	13.6	5.0	0	0	0	16.7	12.5	0	4.5	4.7	3.1
1 year	0	0	0	0	11.1	0	0	0	0	0	33.3	6.3	7.1	0	3.1	0

Table 11 Mean time (# of days) spent on marine education by teachers responding to survey in each county.

County	A. Mean days ± SD spent on marine education (all responding teachers in county)	B. Mean days ± SD (teachers teaching 1 class period or more of marine education)
Lincoln	76.2 ± 82.9	91.5 ± 82.7
Knox	29.8 ± 47.0	34.1 ± 49.5
Washington	24.3 ± 55.3	27.3 ± 58.1
Hancock	16.5 ± 29.6	24.2 ± 33.4
York	15.3 ± 34.6	23.8 ± 40.9
Sagadahoc	14.2 ± 46.3	19.8 ± 54.6
Franklin	10.5 ± 19.9	16.1 ± 22.9
Cumberland	8.2 ± 18.6	12.3 ± 21.7
Waldo	7.8 ± 8.0	9.4 ± 7.9
Somerset	7.0 ± 16.2	9.9 ± 18.6
Androscoggin	6.5 ± 16.4	12.1 ± 21.1
Penobscot	5.1 ± 15.2	9.4 ± 19.8
Oxford	4.7 ± 7.8	7.5 ± 8.9
Kennebec	3.7 ± 5.8	5.4 ± 6.3
Arcostook	3.5 ± 6.7	7.0 ± 8.2
Piscataquis	2.7 ± 6.3	6.8 ± 9.0
Grand Mean	9.6 ± 25.7	15.0 ± 30.9

only those teachers who reported teaching at least 1 class period/year on marine education, revealed the following significant differences: (1) Lincoln was significantly higher than the other counties, (2) Knox was significantly higher than Kennebec, Aroostook, Penobscot, Somerset and Cumberland, (3) Washington was significantly higher than Kennebec, and (4) York was significantly higher than Kennebec and Aroostook. Despite the relatively high degree of variability in the amount of time devoted to marine-related topics by teachers within a given county, there appear to be some distinct differences between counties with respect to the average amount of time devoted to marine education.

Number of Students/Teacher Involved in Marine Education

Tables 12-16 provide data on the number of students teachers involve in marine education, in relation to factors such as county, grade level and distance of the school from the coast. These data must be interpreted with caution since it appears that some teachers misinterpreted the intent of the questionnaire item related to number of students (Item # 4, Appendix 1). The item was intended to give information on the number of students the surveyed teacher personally involved in marine education, although some teachers included students who were receiving marine education from other teachers in their school. These respondents were screened as much as possible from the analyses, although some ambiguities remained.

Table 12 shows the percent of respondents who indicated teaching marine-related topics/activities to various numbers of students. Aside from "0 student" responses (36.6% of the teachers), the most frequent respone was "11-25 students" (29.7% of all respondents), followed by "26-50 students" (17.2% of respondents). About seventy-two percent (71.5%) of the respondents indicated teaching marine education topics/activites to 25 or fewer (including 0) students.

Table 13 gives the percent of respondents who teach marine-related topics to various numbers of students, including only those respondents who actually teach marine education topics to their students. The most frequent number (range) of students involved in marine education in these teachers' classes is 11-25 (46.8% of respondents), followed by 26-50 students (27.2% of respondents). About fifty-five percent (55.1%) of the respondents who indicated teaching marine education topics teach these to 1-25 students during the school year.

Table 14 shows the percent of respondents who indicated teaching marine education topics to various numbers of students, broken down according to the distance of the respondents' schools from the coast. No striking pattern is apparent, although there does seem to be a slight tendency for fewer students to be involved in marine education at distances >100 miles from the coast. This pattern is most markedly upset by 2.5% of the respondents teaching in schools located >100 miles from the coast who reported that they teach marine-related topics to 151-200 students. Most noteworthy is the finding that 52.5% of the teachers surveyed from schools located >100 miles from the coast do not involve any of their students in marine education, compared to <40% of the teachers surveyed from any other distance category. Nevertheless, the lack of a significant relationship between number of

Table 12 Number and percent of responding teachers who teach marine activities or topics to various numbers of students. (52 teachers did not respond to this item; % is based on N=516 respondents).

Number of students taught marine education topics/activities by responding teachers	Number of teachers	% of respondents (N=516)	Cumulative %
0	189	36.6	36.6
1 - 5	16	3.1	39.7
6 - 10	11	2.1	41.8
11 - 25	153	29.7	71.5
26 - 50	89	17.2	88.7
51 - 100	40	7.8	96.5
101 - 150	14	2.7	99.2
> 150	4	0.8	100.0

Table 13 From the subsample of teachers who reported teaching marine education topics to at least 1 - 5 students (N=327), number and percent who teach these topics to various numbers of students.

Number of students taught marine education topics or activities	Number of teachers	% of respondents (N=327)	Cumulative %
1 - 5	16	4.9	4.9
6 - 10	11	3.4	8.3
11 - 25	153	46.8	55.1
26 - 50	89	27.2	82.3
51 - 100	40	12.2	94.5
101 - 150	14	4.3	98.8
> 150	4	1.2	100.0

Table 14 Percent teachers teaching in schools located various distances from the coast who reported teaching marine-related topics to various numbers of students. (N=number of responding teachers)

Number of students receiving instruction in marine-related topics/ activities from teachers surveyed	Distance from Coast (miles)			
	0 - 10 (N=161)	11 - 50 (N=168)	51 - 100 (N=106)	> 100 (N=80)
0	26.1	39.9	35.9	52.5
1 - 10	6.8	2.4	6.6	6.3
11 - 25	37.3	24.4	34.0	18.6
26 - 50	18.6	22.6	11.3	10.0
51 - 100	8.1	7.1	8.5	7.5
101 - 150	2.5	3.0	3.8	1.3
151 - 200	0.6	0.6	0.0	2.5

students involved in marine education and distance from the coast was borne out by insignificant and small correlations between these variables. When all respondents were considered, the correlation between distance of teachers' schools from the coast and the number of students the teachers involved in marine education topics was r= -0.05 (p=.23). When only those teachers who involve at least 1-5 students in marine education were included in the analysis, the correlation between number of students and distance from the coast was r=0.06 (p=.15). Our survey data seem to suggest, therefore, that although more time is spent on marine education in coastal or near-coastal areas than in regions further inland, the number of students involved in some form of marine education may not be dramatically different in coastal, near-coastal and inland areas. The student data must be viewed with caution, however. Student numbers were not exact, representing ranges (see Item #4, Appendix 1), and the midpoints of these ranges were used in the correlation analyses. Futher research efforts are required to determine more precisely whether or not there is a difference between coastal and inland schools in terms of the number of students receiving instruction in marine-related topics.

Table 15 gives the mean number of students/teacher who receive some form of marine-related instruction, broken down by county. The data in column A represent an analysis based on all respondents from each county, whereas column B presents data based on only those teachers in each county who reported involving at least 1-5 students in marine-related topics/activities. The numbers are approximate since the midpoint of student ranges were used. Analysis of variance and Duncan's multiple range test revealed no significant differences between any of these county means at the 0.05 significance level, for both analyses (columns A and B). The means in column A (all respondents) ranged from a high of 34 students/teacher involved in marine education in Waldo county, to a low of 8 students/teacher in Piscataquis county. When only those teachers from each county who teach marine education to at least 1-5 students were considered (column B), the means ranged from a high of 44 students/teacher in Franklin county, to a low mean of 19 students/teacher in Piscataquis. Although the means in both columns A and B range widely, the high variability within each county, coupled with a wide range in the number of respondents from each county, resulted in non-significant differences between the means. Also shown in Table 15 are the grand mean number of students/teacher receiving some form of marine instruction when all respondents were considered (23 students/teacher), and when only those teachers who indicated teaching marine topics to at least 1-5 students were included in the analysis (36 students/teacher).

Table 16 gives the mean number of students/teacher at the various grade levels who receive some form of marine-related instruction. Again, these numbers are approximate since they are based on the midpoint of the student number ranges indicated on the survey questionnaire. Also, it must be emphasized that these data are based only on those teachers who indicated teaching marine topics/activities to their classes. Analysis of variance and Duncan's multiple range test revealed significant differences ($p<0.05$) between the following means: (1) 7th grade teacher respondents who indicated teaching marine topics involve a significantly greater number of students (mean=58) than corresponding teachers in grades 1-6 and 10-12, (2) 8th grade teachers who teach marine education topics involve significantly more

Table 15 Mean number of students per responding teacher who receive marine instruction, by county. N_1 = all teacher respondents from county; N_2 = teacher respondents from each county who teach marine education topics

County	N_1	A. Mean number of students/ teacher receiving marine instruction, based on all respondents from each county (± SD)		N_2	B. Mean number of students/ teacher receiving marine instruction, based on number of teachers in each county who teach marine topics (± SD)	
Waldo	17	34	(30)	14	41	(28)
Franklin	20	29	(34)	13	44	(34)
Knox	16	28	(32)	14	32	(32)
Lincoln	6	28	(26)	5	33	(25)
York	57	26	(41)	38	39	(44)
Somerset	30	25	(28)	22	34	(27)
Cumberland	81	23	(28)	52	36	(28)
Penobscot	66	23	(36)	36	44	(39)
Kennebec	62	22	(26)	42	33	(25)
Hancock	22	21	(23)	15	31	(22)
Washington	16	20	(12)	14	23	(10)
Sagadahoc	12	20	(23)	8	29	(23)
Androscoggin	28	18	(28)	14	37	(30)
Aroostook	53	18	(32)	24	39	(39)
Oxford	19	17	(24)	11	29	(25)
Piscataquis	10	8	(13)	4	19	(15)

Table 16 Mean number of students receiving marine-related instruction per teacher respondent, by grade level. Only teachers who indicated teaching marine-related topics are included in the analysis. N= number of teachers.

Grade Level	N	Mean number of students/teacher (± Standard Deviation)	
7	43	58	(44)
8	31	57	(39)
9	29	50	(39)
K	34	43	(36)
6	43	41	(32)
10	35	34	(25)
12	35	34	(27)
11	33	33	(23)
1	31	32	(40)
5	40	31	(30)
3	48	29	(33)
2	40	28	(36)
4	53	28	(27)

students than corresponding teachers in grades 1-5 and 10-12, and (3) 9th grade teachers who teach marine education topics involve significantly more students than teachers in grades 2-4. These data lead to the tentative conclusion that, of those public school students receiving some form of marine education, more of them receive this education in 7th, 8th and 9th grade than in most of the other grades. This does not mean, however, that the proportion of students receiving marine education at each grade level follows the same pattern. For example, although more students may be receiving marine education in 7th grade relative to other grades when marine education topics are taught, there may be a higher proportion of 7th grade teachers than teachers at some other grade levels who do not teach any marine-related topics at all. We do not have data on this. Consequently, we cannot conclude that, of the total population of Maine public school students, more of them are getting exposed to marine education in 7th grade than at any other grade level. This is an issue open to further investigation. We can tentatively conclude that, for various possible reasons (class size?), 7th, 8th and 9th grade teachers who teach marine education topics seem to involve more students than teachers who teach marine topics at some of the other grade levels.

General School Subject Areas in which Marine Education Topics are Taught

Tables 17-18 present data on the percent of teachers who indicated incorporating marine education topics/activities into various general school subject areas. Only those respondents who reported teaching marine-related topics are included in the analysis (N=368). Table 17 shows that marine topics are most frequently taught in cunjunction with earth science, followed by social studies, language arts, art and biology. Numerous respondents (N=80, or 21.7% of those who teach marine education topics) reported teaching marine topics in conjunction with general subject areas other than those on the survey instrument. A list of these other subject areas is given in Table 18. It should be emphasized that the percentage of teachers using marine topics in the various subject areas in Table 17 do not reflect the number or percent of respondents who specifically teach that subject area as a separate discipline. For example, 64 teachers indicated that they incorporate marine topics with biology. This does not mean that these 64 teachers were all biology teachers. Many elementary teachers indicated that they incorporate marine topics and concepts with general biology lessons.

Marine Topics Taught

Tables 19-27 present information on the number and percent of respondents who teach various marine topics and on the mean number of marine topics taught, in relation to such factors as distance of a teacher's school from the coast, county and grade level. Table 19 shows the number and percent of respondents who reported teaching various marine topics in their classes. The five most frequently-taught marine topics are whales, lobsters, fish and fishing, seaweeds and sharks. These topics were taught by about 24-34% of all respondents, and by 37-53% of those respondents who indicated teaching marine topics. About 15% of the respondents who teach marine topics in their classes teach topics other than (or in addition to) those that were listed on the survey instrument. These other topics are shown in Table 20.

Table 17 Number and percent of teachers who indicated using marine-related topics/activities in conjunction with various general subject areas. Analysis is based only on teachers who reported teaching marine education topics. N=368.

Subject Area	Number of teachers who teach marine education topics in the subject area:	% of teachers, of those who teach marine-related topics, who teach these topics in the subject area:
Earth Science	157	42.7
Social Studies	135	36.7
Language Arts	75	20.4
Art	72	19.6
Biology	64	17.4
Math	28	7.6
English	17	4.6
Home Economics	17	4.6
Chemistry	5	1.4
Physics	5	1.4
Industrial Arts	0	0.0
Other Subject Areas	80	21.7

Table 18 General subject areas, other than those listed on survey instrument, in which some of the teachers surveyed use marine-related activitities/topics.

1. Food Science
2. IPS
3. General Science--elementary to secondary
4. Maine Studies
5. Maine History and Economics
6. Environmental Science
7. Life Sciences
8. Vocational Child Care
9. Reading
10. Speech
11. Physical Science
12. Vocational Building and Trades
13. Ecology
14. Geography
15. Oceanography
16. Vocational Education
17. Special Education
18. Cooperative Education
19. Pre-vocational
20. Writing Process
21. Remedial reading
22. Literature
23. Multidisciplinary studies
24. Electronics (Vocational)

Table 19 Number and percent of teachers who reported teaching various marine topics.

Marine topic	Number of teachers reporting that they teach topic	% of those respondents who teach marine-related topics (N=361)	% of all respondents (N=568)
1. Whales	191	52.9	33.6
2. Lobsters	180	49.9	31.7
3. Fish & Fishing	155	42.9	27.3
4. Seaweeds	138	38.2	24.3
5. Sharks	135	37.4	23.8
6. Marine biology	91	25.2	16.0
7. Marine ecology	80	22.2	14.1
8. Salt marshes	77	21.3	13.6
9. Coastal issues	76	21.1	13.4
10. Ships/navigation	68	18.8	12.0
11. Marine geology	66	18.3	11.6
12. Gulf of Maine	65	18.0	11.4
13. Physical oceanography	61	16.9	10.7
14. Maritime heritage	59	16.3	10.4
15. Seafood cooking	49	13.6	8.6
16. Estuaries	43	11.9	7.6
17. Aquaculture	39	10.8	6.9
18. Marine art	38	10.5	6.7
19. Georges Bank	28	7.8	4.9
20. Chemical oceanography	21	5.8	3.7
21. Other	56	15.5	9.9

Table 20 Marine-related topics, other than those listed on survey instrument, taught by some of the teachers surveyed.

1. Maine coastal geography
2. General ocean environment
3. Quoddy Project, off-shore oil
4. Marine Archaeology
5. Nautical terminology
6. Tide pools
7. Swimming
8. Light houses, Coast Guard
9. Seafood economics ("Buy Maine")
10. Marine Pollution
11. Construction of pilings and frameworks around salt water
12. Marine industries
13. Marine political issues--territorial waters, continental shelf
14. Collection and preservation of marine organisms
15. Marlinspike seamanship
16. Fiberglass repair
17. Small boat handling
18. "Law of the Sea" -- World Court Decision
19. Pharmacology derived from marine life
20. Marine career awareness

Table 21 shows the mean number of marine topics taught by respondents in relation to the distance of the respondents' schools from the coast. The mean number of marine topics taught by all respondents declined as distance from the coast increased (column A). Analysis of variance and Duncan's multiple range test revealed a significiant difference ($p<0.05$) between the number of marine topics taught by teachers who teach within 10 miles of the coast (mean= 4.0 topics) and teachers who teach in schools located 11-50, 51-100 and >100 miles from the coast. A decline in the number of marine topics taught as distance from the coast increases was also noted in the sub-population of teachers who teach marine education topics (column B). In this group of teachers, a significant difference ($p<0.05$) in the number of topics taught was found between teachers who teach within 10 miles of the coast (mean= 5.4 topics) and those who teach in schools located 51-100 miles from the coast (mean = 4.0 topics). Table 21 also shows that the grand mean number of marine topics taught by all respondents to the survey was 3.4, compared to a grand mean of 4.8 topics for teachers who indicated teaching marine topics in their classes. Correlation analysis supports the data in Table 21. The correlation between number of marine topics taught and distance from the coast was $r=-0.18$ ($p<0.001$) for all respondents, and $r=-0.14$ ($p<0.001$) for teachers who indicated teaching marine topics. Although the relationships are weak, with distance from the coast explaining only about 2-3% of the variance in number of marine topics taught, there does seem to be a tendency of fewer marine topics being taught as distance from the coast increases.

Tables 22-24 show relationships between marine topics taught and county. Table 22 shows the mean number of marine topics taught by all respondents from each county. It appears that respondents from Knox county teach the greatest number of marine topics, followed by teachers in Lincoln and Waldo county. Respondents from Aroostook county teach the fewest number of marine topics. The following significant differences were found ($p<0.05$): (1) Knox county was significantly higher than all the other counties, (2) Lincoln and Waldo county were significantly higher than Penobscot, Androscoggin and Aroostook, and (3) York was significantly higher than Aroostook.

Table 23 shows the mean number of marine topics taught by respondents in each county who teach marine topics in their classes. Thus, of those respondents who teach marine topics, those in Lincoln county teach the most, followed by teachers in Knox, Piscataquis and Waldo county. The following significant differences were found ($p<0.05$): (1) Lincoln and Knox were significantly higher than Aroostook and Washington, and (2) Waldo, Hancock and York were significantly higher than Washington. Table 23 also shows the percentage of respondents from each county who indicated teaching marine topics. The highest frequencies of these teachers were in Washington (88.8%), Knox (87.5%) and Waldo (83.3%) county. Overall, the data in Tables 22 and 23 suggest that there are significant differences between certain counties in the number and, perhaps, diversity of marine topics taught.

Table 24 indicates the marine topics taught by at least 25% of all the respondents from a given county. Some distinct differences between counties are apparent. For example, in Aroostook county, most of the listed marine topics, with the exception of seaweeds (topic #4), are taught by less than 25% of the respondents (although all the topics are taught). Seven (7) or

Table 21 Mean number of marine topics taught by respondents, according to distance of respondents' schools from the coast.

Miles from Coast	N (all teachers)	A. Mean number of marine topics taught by all teachers surveyed (± SD)		N (teachers who teach marine ed. topics)	B. Mean number of marine topics taught by teachers who reported teaching marine ed. topics (± SD)	
0 - 10	179	4.0	(4.2)	132	5.4	(4.0)
11 - 50	183	2.8	(3.5)	111	4.6	(3.4)
51 - 100	117	2.6	(2.8)	75	4.0	(2.5)
> 100	88	2.0	(2.8)	42	4.3	(2.7)
	Grand Mean	3.0	(3.6)		4.8	(3.5)

Table 22 Mean number of marine topics taught by teachers in each county. N = all respondents in each county.

County	N	Mean number of marine topics taught/teacher surveyed (± SD)	
Knox	16	6.8	(4.7)
Lincoln	6	6.2	(4.7)
Waldo	18	4.9	(3.9)
Hancock	23	3.8	(4.7)
York	64	3.5	(4.3)
Franklin	20	3.4	(3.5)
Sagadahoc	14	3.1	(3.9)
Cumberland	93	3.1	(3.4)
Kennebec	65	2.8	(3.0)
Somerset	32	2.8	(3.1)
Oxford	21	2.5	(2.8)
Penobscot	71	2.5	(3.3)
Washington	18	2.5	(3.9)
Piscataquis	10	2.5	(4.5)
Androscoggin	34	2.4	(3.0)
Aroostook	62	1.9	(2.6)
	Grand Mean	3.0	(3.6)

Table 23 Mean number of marine topics taught by teachers who indicated teaching marine topics to their classes, by county. N = number of respondents in each county who reported teaching marine education topics. % = percent of respondents in each county who reported teaching marine education topics

County	N	%	Mean number of marine topics taught/ teacher, among teachers who teach marine education topics (± SD)	
Lincoln	4	66.6	9.2	(5.1)
Knox	14	87.5	7.8	(4.2)
Piscataquis	4	40.0	6.2	(5.3)
Waldo	15	83.3	5.9	(3.6)
Hancock	15	65.2	5.8	(4.8)
York	41	64.1	5.4	(4.3)
Franklin	13	65.0	5.2	(3.0)
Cumberland	62	68.8	4.6	(3.3)
Penobscot	39	54.9	4.6	(3.2)
Oxford	12	57.1	4.4	(2.2)
Sagadahoc	10	71.4	4.4	(4.1)
Androscoggin	19	55.9	4.2	(2.8)
Somerset	22	68.7	4.1	(3.0)
Kennebec	45	69.2	4.1	(2.8)
Aroostook	30	48.4	3.9	(2.7)
Washington	16	88.8	2.8	(2.1)
		Grand Mean	4.8	(3.5)

more of the marine topics are taught by at least 25% of the respondents from Knox, Lincoln, Waldo, Franklin and Hancock county, with a high of 17 topics being taught by at least 25% of the respondents from Knox county. Topics 1-4 are covered by 25% or more of the respondents from at least 50% of the counties. Relatively low proportions of the respondents from most counties, except Knox, address topics 10-20. Some of these topics are not covered by any of the respondents from a number of counties. Overall, these data indicate differences between counties in terms of the diversity of marine topics taught and in the percentage of teachers who address various marine topics in their classes.

Tables 25-27 present data on the number of marine topics taught by respondents at various grade levels. All of these data are based on respondents who indicated teaching marine topics in their classes (that is, exclusion of teachers who reported teaching no marine-related topics). Table 25 shows the number and percent of respondents who indicated teaching marine topics at various grade levels. Of all respondents who reported teaching marine topics, the highest percentage were 4th grade teachers (15.8%), and the lowest percentage were 9th grade teachers (8.6%). Nevertheless, it appears that, in the population of respondents who teach marine topics, there are no striking differences between the percentages of these respondents at the various grade levels. Unfortunately, we have no data on the proportions of teachers who teach and do not teach marine topics <u>at a given grade level</u>.

Table 26 gives the mean number of marine topics taught by respondents at each grade level, including only those teachers who reported teaching marine topics. The data show that, in the population of respondents who teach marine topics, 7th, 8th and 9th grade teachers teach the most topics (means = 5.9, 5.8 and 5.7 topics, respectively), whereas 3rd, 1st and 11th grade teachers teach the least (means = 3.9, 4.0 and 4.0 topics, respectively). However, a statistically significant difference ($p<0.05$) was found only between 7th grade respondents (mean = 5.9 topics) and 3rd and 1st grade respondents (means = 3.9 and 4.0 topics, respectively). The correlation between number of marine topics taught and grade level (again, including only those teachers who teach marine topics) was not signifcant ($r = 0.08$; $p=0.12$). What this means is that, within the population of teachers who teach marine topics, there is no striking tendency for teachers at one grade level to teach more topics than teachers at another grade level.

Table 27 shows the topics taught by at least 25% of the respondents at a given grade level who indicated teaching marine topics. Thus, among respondents who teach marine topics, topics 1-5 (whales, lobsters, fish and fishing, seaweeds and sharks) are addressed by at least 25% of the respondents who teach grades K-10. Topics 6-9 (marine biology, marine ecology, salt marshes and coastal issues) get their primary attention in 6th and 10th grade, and coastal issues appear to be taught fairly frequently by 12th grade teachers who teach marine topics. Topics 11-13 (marine geology, Gulf of Maine, physical oceanography) appear to be covered primarily in the upper elementary and intermediary grades, whereas topic 15 (seafood cooking) is taught mainly from 9th grade on, most likely in home economics courses. Topics 17 (aquaculture), 19 (Georges Bank) and 20 (chemical oceanography) are covered by less than 25% of the respondents at each grade level, and are not taught at all in some of the lower grades. Marine art (topic 18) is

Table 24 Marine topics taught by 25% or more of all respondents in a county (X). See table 19 for list of numbered topics. * = most frequently taught marine topic(s). 0 = topic not taught by any of the respondents in county. N = total number of respondents from each county.

		Topics																			
County	N	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Other
Aroostook	62				X*																	
Somerset	32	X*	X	X	X			X														
Piscataquis	10	X*				X*	0							0		0			0		0	
Penobscot	71	X	X*	X*																		
Washington	18	X*		X*				0				0	0	0			0				0	
Hancock	23	X*	X	X		X	X	X		X									0			
Franklin	20	X*	X	X		X			X	X				X		0			0			X
Oxford	21	X*	X	X	X	X					0				0	0				0		
Waldo	18	X*	X		X		X	X			X	X							X			
Kennebec	65	X*	X	X	X	X																
Lincoln	6	X	X	X	X*		X	X	X	X		X	X	0							0	0
Knox	16	X	X	X	X*	X	X	X	X	X	X	X	X	X	X			X	X	X		
Sagadahoc	14		X*								0				0							
Cumberland	93	X	X*	X																		
York	64	X*	X	X	X	X																
Androscoggin	34	X*	X																			

Table 25 Number and percent of responding teachers who use marine activities or teach marine-related topics at various grade levels. (Note: Some teachers teach more than one grade level).

Grade level	Number of teachers teaching marine-related topics at grade level	% of all respondents teaching marine-related topics (N=361)	% of total respondents (N=568)
K	39	10.3	6.9
1	47	13.0	8.3
2	45	12.5	7.9
3	52	14.4	9.2
4	57	15.8	10.0
5	46	12.7	8.1
6	47	13.0	8.3
7	46	12.7	8.1
8	35	9.7	6.2
9	31	8.6	5.5
10	40	11.1	7.0
11	41	11.4	7.2
12	41	11.4	7.2

Table 26 Mean number of marine topics taught by K-12 teachers who reported that they teach marine topics. N = number of teachers at each grade level who reported teaching marine education topics to their classes.

Grade Level	N	Mean number of marine topics taught/teacher (± SD)	
7	46	5.9	(4.2)
8	35	5.8	(4.4)
9	31	5.7	(5.1)
6	47	5.5	(3.5)
4	57	5.4	(2.8)
5	46	4.9	(3.7)
10	40	4.8	(4.3)
12	41	4.6	(4.7)
2	45	4.5	(2.9)
K	39	4.4	(2.6)
11	41	4.1	(4.2)
1	47	4.0	(2.5)
3	52	3.9	(2.5)
	Grand Mean	4.8	(3.5)

Table 27 Marine topics taught by 25% or more of teachers at a given grade level (X). Only those teacher respondents who indicated teaching marine education topics are included in the analysis. N = number of teachers. * = most frequently taught topic at a given grade level. 0 = topic not taught by any teacher at a given grade level. See table 19 for names of numbered topics.

Grade	N	Topics																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Other
K	39	X	X*	X	X	X											X	0	X	0	0	
1	47	X*	X	X	X	X												0	X	0	0	
2	45	X*	X	X	X	X														0	0	
3	52	X*	X	X	X	X			X											0	0	
4	57	X	X*	X	X	X			X			X									0	
5	46	X*	X	X	X	X	X				X				X		X					
6	47	X*	X	X	X	X	X	X	X	X		X	X				X					
7	46	X	X*	X	X	X	X	X	X	X		X	X				X					
8	35	X*	X*	X	X	X	X	X	X	X		X	X	X			X					
9	31	X	X	X*		X		X	X	X*	X		X*	X	X	X						X
10	40	X	X*	X	X	X	X	X		X						X	X		0			X
11	41										X					X*						X
12	41			X						X*	X					X						X*

included primarily in kindergarten and 1st grade. Starting in 9th grade, marine topics other than those listed on the survey questionnaire are taught fairly frequently.

Marine Curricula

A total of 148 respondents indicated that they were familiar with or had used at least one of the marine curricula listed in Table 28. This represents 26.1% of the total number of respondents (N=568). All of these 148 respondents were teachers who indicated teaching marine education topics in their classes. Since 361 respondents reported teaching marine topics, this means that 41.0% of these teachers (148/341) had either used or were familiar with at least one of the marine curricula. Conversely, the majority (59.0%) of these teachers were not familiar with or had never used any of the curricula.

Table 29 gives the number and percent of respondents who have used or are familiar with the various marine curricula in Table 28. The most familiar or most frequently used curriculum was #11, followed by curricula #2 and #1. The data show that none of the curricula, with the exception of #11, was familiar to or used by more than 10% of all respondents, or by more than about 15% of respondents who teach marine topics. Ninety-nine teachers, representing 17.4% of all respondents and 27.4% of those respondents who teach marine topics indicated using marine education resources, activities or curricula other than or in addition to those listed on the survey questionnaire. A list of these is given in table 30. This is a rather diverse list, although the most common alternative marine education resources appeared to be ones developed by the teacher him/herself, and textbook chapters devoted to marine topics.

Table 31 gives usefulness ratings (in % teachers) of the various curricula in Table 28. Curriculum #11 had the most frequent top usefulness rating, followed by curricula #19, #2, #7 and#12. Curricula 13, and 15-18 were considered not useful by the majority of respondents who rated them.

Table 32 shows the number and percent of respondents in each county who indicated having used or being familiar with at least one of the marine curricula, in terms of both total number of respondents from each county and number of respondents in each county who teach marine education topics. In both cases, a greater percentage of respondents in Lincoln, Knox and Waldo county were familiar with at least one of the curricula than were respondents in the other counties. The lowest frequency of familiarity with these curricula was among respondents from Aroostook county.

Table 33 indicates the marine curricula familiar to at least 25% of the respondents in each county who indicated teaching marine education topics. It appears that, with the exception of respondents in Lincoln and Waldo county, relatively low percentages of teachers (0-23%) who teach marine education topics in the other counties are familar with or have used these marine curricula.

Table 34 presents mean usefulness ratings for the various marine curricula, by grade level. Generally, curricula 2, 5-8, 10-12, 14 and 19

were rated more useful by K (or 1)-6th grade teachers than by 7th-12th grade teachers. Curricula 1, 3, 4 and 9 generally were rated moderately to mostly useful, with no striking grade-level differences. Curriculum 13 was rated slightly to moderately useful, again with no striking grade-level rating differences. Curricula 15-18 were rated not useful to moderately useful, with 7th-12th grade teachers rating these curricula higher than K-6 teachers.

Table 28. List of marine curricula which teachers were asked to rate. Curricula 1-10 are marine infusion units of the Northern New England Marine Education Project (NNEMEP), University of Maine.

Curriculum Number	Curriculum Name
1	What are the ABC's of marine education?
2	Have you been to the shore before?
3	What is our maritime heritage?
4	How do people use lighthouses and navigational charts?
5	What adventures can you have in wetlands, lakes, ponds and puddles?
6	Is our food future in the sea?
7	Do you know our marine fishes?
8	Do you know our marine algae?
9	Whale multidisciplinary studies?
10	What is our coastal future?
11	Maine Department of Marine Resources Marine Education Activities
12	College of the Atlantic (Whale Education Program)
13	Project COAST (University of Delaware)
14	Maine Science Studies Curriculum
15	Coastal Problems and Resource Management (Hawaii)
16	Project Oceanology (Groton, Connecticut)
17	High School Marine Studies Curriculum (Hawaii)
18	Floating Laboratory Manual (University of New Hampshire)
19	Voyage of the Mimi (Bank Street School)

Table 29. Number and percent of teachers who reported that they have used or are familiar with the following marine curricula (see Table 28 for names of curricula). * = highest familiarity or frequency of use.

Curriculum	Number of respondents who have used or are familiar with curriculum	% of total respondents familiar with curriculum (N=568)	% of respondents teaching marine topics who are familiar with curriculum (N=361)
1*	48	8.5	13.3
2*	55	9.7	15.2
3	35	6.2	9.7
4	35	6.2	9.7
5	38	6.7	10.5
6	39	6.9	10.8
7*	43	7.6	11.9
8	36	6.3	10.0
9	30	5.3	8.3
10	29	5.1	8.0
11*	73	12.9	20.2
12*	43	7.6	11.9
13	19	3.3	5.3
14	25	4.4	6.9
15	19	3.3	5.3
16	17	3.0	4.7
17	22	3.9	6.1
18	19	3.3	5.3
19*	44	7.7	12.2
Other	99	17.4	27.4

Table 30 List of curricula and marine-related resource materials, other than those listed on survey instrument, used by some of the teachers surveyed.

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1. Teacher-developed materials
2. Textbook currently used by teacher
3. Film strips
4. Obis-activities
5. Mr. and Mrs. Fish
6. Connections to Forest and Sea (4-H)
7. Guest speakers and volunteer resources
8. Magazines
9. Geologic models
10. Maine Audubon Society materials
11. "Earth's Rocks and Soil"
12. University of New Hampshire Tidepool Times
13. Pictures, photos of seascapes
14. Gulf of Maine Aquarium
15. Maps
16. Marine boat cruises
17. Science supplements
18. National Geographic materials
19. Saco Aquarium
20. Department of Educational and Cultural Services Curriculum guide for the inshore fisheries
21. Seatrek - Univ. of New Hampshire
22. Odiorne Point Project, UNH
23. "Operation Sea Specimen", Maine Maritime Academy
24. Investigating the Marine Environment and its Resources, Sea Grant College Program, Texas A&M
25. Weekly Reader
26. Materials from Oceanarium, S.W. Harbor, Maine
27. Shell collection for identification and study
28. Seashore stories
29. Andre the Seal
30. "The Taste of Maine" brochures, seafood cooking
31. "Come With Me" series
32. Library books on the sea
33. Marine fisheries of Maine
34. Maine Aquarium
35. Scarborough Marsh
36. Maine, My State
37. Time/Life--The Sea
38. Globe-Oceanography and Our Future
39. Lorraine Stubbs--"Ocean to Classroom" traveling exhibit
40. Penobscot Marine Museum Materials
41. Woods Hole Oceanographic Institute materials
42. MPBN--Island Institute
43. Newspapers, for current marine topics
44. Materials from St. Andrews Aquarium, New Brunswick
45. Maine "Dirigo" text and materials
46. Sea Weel (Belfast, Maine)
47. Stone Environmental School, Ocean Park--marsh and seashore programs

Table 30 (continued)

48. Marine Literature--Kon Tiki, Moby Dick, The Sea Wolf, Mutiny on the Bounty
49. Project Earth
50. Alaska Sea Grant materials
51. Field trips to the coast
52. Scholastic News materials
53. National Geographic--Books for World Explorers
54. Spizzari--Marine coloring books

Table 31 Number and percent of teachers in each county who indicated being familiar with or having used at least one of the marine curricula in Table 28.

County	Number of respondents familiar with at least one marine curriculum	% of total respondents in county familiar with at least one marine curriculum	% of respondents in county teaching marine topics who are familiar with at least one marine curriculum
Lincoln	4	66.7	100.0
Knox	9	56.3	64.3
Waldo	9	50.0	60.0
Sagadohoc	5	35.7	50.0
York	19	29.7	46.3
Somerset	9	28.1	40.1
Franklin	5	25.0	38.5
Cumberland	23	24.7	37.1
Kennebec	16	24.6	35.6
Oxford	5	23.8	41.7
Penobscot	16	22.5	41.0
Washington	4	22.2	25.0
Hancock	5	21.7	33.3
Androscoggin	7	20.6	36.8
Piscataquis	2	20.0	50.0
Aroostook	10	16.1	33.3

Table 32 Curricula familiar to at least 25% of respondents in each county who teach marine topics. See Table 28 for names of curricula.
0 = no respondent familiar with curriculum. Blank space = 2-23%

County	Curriculum 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Aroostook		X						X											
Somerset			0	0			0	0	0	0		0	0	0	0	0	0	0	0
Piscataquis	X	X	0	0	0	0	0	0	0	0	X	0	0	0	0	0	0	0	0
Penobscot																			
Washington				0					0			0	0	0	0	0	0	0	0
Hancock				0		0		0	0										
Franklin	0									0			0	0	0	0	0	0	0
Oxford	X												0						
Waldo	X	X	X	X	X	X	X	X	X		X		X					X	
Kennebec																			
Lincoln	X	X	X	X	X	X	X	X	0	0	X	X	X	X	X	0	X	0	X
Knox												X							X
Sagadahoc											X			0	0	0	0	0	0
Cumberland																			
York													0						
Androscoggin																			

Table 33 Teacher ratings of curricula. See Table 28 for names of curricula. * = most frequent rating of curriculum.

Curriculum	Ratings (% teachers) Not Useful	Slightly Useful	Moderately Useful	Mostly Useful	Very Useful
1	12.5	6.3	33.4*	29.2	18.8
2	7.3	1.8	14.5	36.4	40.0*
3	11.4	5.7	28.6	34.3*	20.0
4	11.4	11.4	25.7	42.9*	8.6
5	7.9	7.9	18.4	34.2*	31.6
6	5.1	15.4	28.2*	25.6	25.6
7	4.7	11.6	16.3	32.6	34.9*
8	16.7	8.3	25.0	33.3*	16.7
9	16.7	26.7	10.0	36.7*	10.0
10	6.9	13.8	34.5*	13.8	31.0
11	2.7	5.5	19.2	24.7	47.9*
12	18.6	11.6	14.0	23.3	32.6*
13	52.6*	15.8	15.8	10.5	5.3
14	28.0*	16.0	20.0	20.0	16.0
15	68.4*	10.5	21.1	0	0
16	52.9*	17.6	17.6	11.8	0
17	54.5*	9.1	22.7	13.6	0
18	57.9*	10.5	15.8	10.5	5.3
19	18.2	6.8	22.7	11.4	40.9*

Table 34 Mean usefulness ratings of various marine curricula by grade level. See Table 28 for names of curricula. * = mean rating score of "mostly to very useful". Key: 0 = not useful, 1 = slightly useful, 2 = moderately useful (average) 3 = mostly useful, 4 = very useful. NR = not rated by any teacher at that grade level.

Curriculum	Grade level													
	K	1	2	3	4	5	6	7	8	9	10	11	12	Grand Mean
1	2.4	2.5	2.7	2.6	2.8	2.4	2.4	2.0	1.7	3.4*	2.4	2.2	2.0	2.4
2	3.4*	3.5*	3.3*	3.5*	3.3*	2.8	2.5	2.8	3.5*	2.8	3.0*	2.9	2.7	3.1*
3	1.9	2.2	2.3	2.8	2.8	2.3	2.3	2.2	2.3	2.5	3.0*	2.5	2.2	2.4
4	1.8	2.0	1.8	2.3	2.5	2.3	2.7	1.8	3.0*	2.3	2.1	1.9	1.8	2.2
5	3.1*	3.3*	3.1*	3.5*	3.1*	2.3	2.5	2.9	2.5	2.5	2.7	2.8	2.4	2.8
6	1.7	3.0*	2.7	3.2*	3.0*	2.8	2.8	2.5	2.5	3.0*	3.3*	2.8	2.4	2.7
7	3.2*	3.5*	3.4*	3.5*	3.1*	2.8	3.0*	2.8	2.8	2.8	3.4*	2.8	2.6	3.1*
8	2.2	3.0*	3.0*	3.0*	2.7	2.6	2.8	3.0*	2.3	2.2	2.8	2.0	1.8	2.7
9	0.7	2.0	2.3	2.3	2.3	2.8	3.0*	1.5	2.5	2.6	2.6	1.7	1.9	2.2
10	1.8	3.3*	3.0*	3.3*	2.9	3.3*	3.0*	2.5	3.9*	2.5	2.5	2.0	1.9	2.8
11	3.4*	3.6*	3.4*	3.6*	3.3*	3.4*	2.9	2.8	2.9	2.4	3.2*	2.7	2.6	3.1*
12	2.6	3.6*	3.6*	3.5*	3.0*	3.5*	3.6*	2.3	2.4	1.7	1.6	1.0	1.0	2.6
13	0.7	2.0	2.0	2.0	0.7	2.0	2.0	1.0	2.5	1.4	1.5	1.2	1.4	1.6
14	3.0*	2.5	3.5*	3.0*	1.2	3.0*	3.3*	2.0	2.0	1.7	2.3	1.8	1.5	2.4
15	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.8	0.3	1.0	1.7	1.3	1.0	0.5
16	0.0	NR	2.0	NR	0.0	NR	NR	1.0	0.5	1.8	2.3	1.8	1.6	1.2
17	0.6	0.0	1.0	0.0	0.0	0.0	0.0	1.2	0.3	1.7	2.0	1.3	1.5	0.7
18	0.8	NR	NR	NR	0.0	NR	2.0	1.0	0.5	1.4	2.3	1.8	1.4	1.2
19	0.7	2.7	2.7	3.5*	2.9	3.5*	3.3*	2.0	2.7	2.2	2.0	1.5	1.2	2.4

CONCLUSIONS AND DISCUSSION

The results of this survey can be summarized in terms of the following general conclusions:

(1) If sampling biases are assumed to have been minimal, then the majority of Maine teachers (about 64%) appear to include some form of marine education in their teaching; 36% devote no time to marine-related topics, most likely because they view their teaching assignments to be unrelated to marine education.

(2) The majority of teachers (about 60%) devote anywhere from 0-1day on marine education topics; 24% devote 1 class period to 1 day to marine education, and about 40% devote more than 1 day to marine education (with "1 week" being the most common response among these teachers). The average amount of time per school year devoted to marine education by Maine teachers is approximately two weeks (9.6 days).

(3) In the sub-population of teachers who devote time to marine-related topics/activities, about 68% spend anywhere from 1 class period to 1 week on marine topics, with 1 week being most common (about 32% of these teachers). These teachers devote an average of three weeks (15 days) per year to marine education topics/activities.

(4) In the sub-population of teachers who devote time to marine-related topics/activities, no striking differences are evident between grade levels in the amount of time spent on marine topics.

(5) There is a statistically significant, although weak, negative correlation between distance from the coast and time spent on marine education.

(6) With a few exceptions, teachers in coastal counties spend more time on marine education topics than do teachers in inland counties and, generally, a greater proportion of teachers in coastal counties than in inland counties teach marine-related topics.

(7) Although there is high variability in the amount of time devoted to marine-related topics among teachers in any given county, on average, teachers in Lincoln, Knox, Washington and York county seem to spend significantly more time on such topics than do teachers in some of the other counties.

(8) There appears to be no significant relationship between the number of students receiving some form of marine-related instruction and distance of the students' schools from the coast; thus, although more time is spent on marine topics in coastal or near-coastal areas than in inland areas, the number of students receiving some minimal amount of marine-related instruction may not be significantly different in these areas. This conclusion is tentative since the data on student numbers are estimates.

(9) Although there is a wide range between counties in the average number of students/teacher receiving some form of marine-related instruction, there

are no statistically significant differences between counties in the number of students/teacher receiving such instruction.

(10) In th sub-population of teachers who teach marine-related topics, those who ach at the 7th-9th grade levels appear to involve more students in marine-related lessons than do teachers at other grade levels.

(11) Marine-related topics appear to be most frequently taught in conjunction with lessons in earth science, social studies, language arts, art and biology. They are least frequently taught in conjunction with industrial arts, physics and chemistry.

(12) Of those topics that were listed on the survey instrument, the ones most frequently taught are: whales, lobsters, fish and fishing, seaweeds and sharks. The least frequently taught topics are: chemical oceanography, Georges Bank, marine art and aquaculture.

(13) As distance from the coast increases, fewer marine-related topics are taught.

(14) The proportion of teachers in a given county who teach marine-related topics appears to be highest in Washington, Knox and Waldo county (83-88% of respondents from these counties indicated teaching marine-related topics).

(15) The average number of marine topics taught by teachers in Knox, Lincoln, Waldo, York and Hancock county is significantly higher than the average number of such topics taught by teachers in some of the other counties.

(16) Within the sub-population of teachers who teach marine-related topics, the highest proportion of these teachers appear to teach at the 4th grade level (15.8%), and the lowest proportion teach at the 9th grade level (8.6%). Overall, however, teachers who teach marine-related topics seem to be distributed fairly evenly among the various grade levels, and no striking grade level patterns are evident.

(17) In the sub-population of teachers who teach marine-related topics, the average number of marine topics taught/teacher appears to be highest at the 7th, 8th and 9th grade level, and lowest at the 1st, 3rd and 11th grade level; however, most of the grade level differences in the number of marine topics taught by teachers who teach such topics are not statistically significant (with the exception of a significant difference between 7th grade and 3rd and 1st grade).

(18) In the sub-population of teachers who teach marine-related topics, no significant correlation exists between grade level and number of marine topics taught.

(19) Within the sub-population of teachers who teach marine-related topics, there are distinct differences between grade levels in the frequency of teachers teaching various specific marine topics. That is, certain marine topics are more likely to be taught at some grade levels than at others.

(20) Familiarity with or use of the marine curricula listed on the survey questionnaire generally was low. About 25% of all respondents and 41% of those respondents who indicated teaching marine topics were familiar with or had used at least one of these curricula. Conversely, about 75% of all respondents and 59% of those respondents who indicated teaching marine topics were not familar with any of the listed marine curricula.

(21) Of the marine curricula listed on the survey questionnaire, the most familiar or most frequently used appears to be the "Maine Department of Marine Resources Marine Education Activities", followed by "Have you been to the shore before? (NNEMEP infusion unit)", and "What are the ABC's of marine education? (NNEMEP infusion unit)".

(22) No single marine curriculum listed on the survey instrument, with the exception of the "Maine Department of Marine Resources Marine Education Activities", was familar to or used by more than 10% of all responding teachers, or more than about 15% of those respondents who indicated teaching marine-related topics/activities.

(23) About 17% of all respondents and 27% of those respondents who indicated teaching marine topics use marine education resources or activities other than or in addition to the marine curricula listed on the survey questionnaire. The most common alternative marine education resources are teacher-developed materials and textbook chapters devoted to marine topics.

(24) The "Maine Department of Marine Resources Marine Education Activities" received the most frequent rating of high usefulness, follwed by "Voyage of the Mimi (Bank Street School)", "Have you been to the shore before? (NNEMEP infusion unit)", "Do you know our marine fishes? (NNEMEP infusion unit)" and "College of the Atlantic (Whale education program)". Marine curricula that were considered not useful by the majority of respondents who were familiar with them were: "Project COAST (Univ. of Delaware)", "Coastal problems and resource management (Hawaii)", "Project Oceanology (Groton, Connecticut)", "High school marine studies curriculum (Hawaii)", and "Floating laboratory manual (Univ. of New Hampshire)". The comments of numerous respondents suggest that degree of usefulness was judged primarily by the criterion of whether or not a marine curriculum or educational resource related specifically to the state of Maine.

(25) Based on all respondents from a given county, familiarity with or use of at least one of the marine curricula listed on the survey instrument was highest on the part of teachers from Lincoln, Knox and Waldo county, and lowest on the part of respondents from Androscoggin, Piscataquis and Aroostook county. Based on respondents from each county who indicated teaching marine education topics, familiarity with or use of at least one of the listed marine curricula was highest on the part of respondents from Lincoln, Knox and Waldo county, and lowest on the part of respondents from Washington, Hancock and Aroostook county.

(26) In most counties, with the exception of Lincoln and Waldo, over 75% of the respondents who indicated teaching marine education topics were unfamilar with most (> 83%) of the marine curricula listed on the survey questionnaire.

(27) The usefulness ratings of some of the marine curricula listed on the survey instrument varied between grade levels, suggesting that certain curricula may be more appropriate for some grade levels than for others.

Surveys of this nature are not common in the research literature. However, several surveys on marine education conducted in two different states provide a basis for comparison. The first of these was conducted in California by Thornley (1981). She found that certain counties in that state were under-represented in marine education, that organized marine education courses are few, with other subjects providing some unknown amount of coverage of marine topics, that K-8 science textbooks devote less than 3% of their pages to marine topics, and that schools and teachers in that state generally are unaware of marine education resources. Similarly, our survey revealed certain counties in Maine to be under-represented in marine education, that coverage of marine topics appears to be restricted to a few general subject areas, and that many teachers, including most of those who teach marine-related topics, have a limited awareness of existing marine education curricula. Futhermore, the comments of numerous respondents to our survey suggest that many teachers in Maine probably cover marine topics primarily through the textbooks they use, and that these textbooks often devote relatively few pages to marine topics.

Our survey results also may relate indirectly to Fortner and Teates' (1980) study of student knowledge and attitudes concerning the oceans. These researchers studied 10th grade students in Virginia and found that coastal students scored higher than did inland students on knowledge questions about the marine environment, although no differences were found between these groups with regard to their attitudes towards the ocean. Based on our teacher survey results, it seems reasonable to speculate that differences in knowledge of the marine environment between coastal and inland students may be explained, at least partly, by different degrees of emphasis and different amounts of time spent on marine-related topics/issues by coastal versus inland teachers. In fact, coastal students in the Fortner and Teates study rated their regular school classes slightly higher (although not significantly higher) than did inland students in contributing to their knowledge and attitudes of the marine environment. Both groups of students rated televison specials, movies and magazines to be more influential than school classes in shaping their knowledge and attitudes of the ocean. Fortner and Teates concluded that regular school classes in Virginia have a limited impact on students' knowledge and attitudes of the ocean, indicating a need for the "inclusion of more marine information...in a planned educational setting" (p. 18).

Evidence from our survey and from recent research on Maine students' knowledge of critical issues related to the Gulf of Maine (Brody and Koch, 1985) suggests a need for the inclusion of more marine education in Maine's public schools, and that this need is greater in inland versus coastal areas of the state. Although many Maine teachers are resourceful in locating, gathering and developing their own marine education materials (see table 30), it was somewhat surprising that 59% of those respondents to our survey who indicated teaching marine-related topics were not familiar with any of the fairly well-established marine curricula listed on the survey questionnaire. This seems to indicate that marine educator organizations

established to promote marine education in public schools may have to make even greater efforts than they are currently making to reach teachers and their students. About 3.5% of all respondents to the survey and 5.4% of those respondents who indicated teaching marine topics specifically requested more information about the marine curricula listed on the survey questionnaire (see comments in Appendix 2). If these figures are projected to the total population of Maine public school teachers (N = about 21,000), there may be at least 300-325 Maine teachers who would welcome more information about available marine education resources. If each of these teachers taught an average of 25 students, approximately 8,000 students could potentially be affected. This is not an insignificant number.

The finding that (1) the amount of time spent on marine education, (2) the number of marine topics taught, and (3) the proportion of teachers who teach marine education topics all decrease as distance from the coast increases is not altogether surprising. These trends undoubtedly are related to the level of accessibility to the ocean environment, and to local cultural factors and priorities. It seems reasonable that an inland teacher might be inclined to stress the accessible local inland environments and industries (lumbering, agriculture, etc.) over the more distant marine environment and its socio-economic implications. Consequently, it may be somewhat unrealistic to expect the marine education gap between coastal and inland counties to disappear completely. However, the gap can and probably should be narrowed through more extensive efforts on the part of marine educators to reach inland teachers, to raise their awareness of the significance of the marine environment and marine education both to the state and to the world and, above all, to offer practical assistance. It is unfortunate that marine education conferences designed to assist teachers in incorporating marine education topics/activities into their existing curriculum are almost invariably held in coastal towns. There are, of course, practical reasons for this. However, the teachers reached by these conferences may not be the ones who need the most encouragement and assistance. Inland teachers may find the distances they have to travel to these conferences prohibitive, or they may feel that they would be "out of their environment". A creative alternative (and a realistic one, based on our survey results) would be to hold a marine conference somewhere in the middle of the state, some distance removed from the ocean. Such a conference would serve as a role model to inland teachers, in that it would demonstrate that the ocean environment can, in fact, be brought to the inland classroom in one form or another without an inordinate expenditure of effort.

Our survey suggests that there are no significant differences between grade levels in the the amount of time devoted to marine education and in the number of marine topics taught by teachers who devote time to marine education topics. However, since we lack data on the proportions of teachers at each grade level who teach and do not teach marine-related topics, we do not know if there are overall differences in the relative amounts of exposure to marine topics and issues students are getting at various grade levels. It does appear that students are exposed to different marine topics at different grade levels and that there is an increasing trend in the diversity of marine topics taught, starting at the 4th grade level. With regard to the various marine topics taught, it is somewhat disappointing that such topics as aquaculture and Georges Bank appear to be receiving only limited attention. These are vital topics because they concern issues of

present and future use and supplies of living marine resources. Aquaculture is an important and growing industry in Maine. Georges Bank is a critical topic not only because the ecological dynamics of this area of the Gulf of Maine explain much of the Gulf's species productivity, but also because it is the central issue in the on-going maritime boundary dispute between the United States and Canada. Both aquaculture and Georges Bank provide opportunities for a multidisciplinary approach to marine education, since these topics involve natural science, economic, social and political concepts/issues relevant to Maine.

The survey results on teachers' usefulness ratings of the various marine curricula listed on the survey questionnaire showed that the respondents gave 73% of these curricula an overall average rating falling between "moderately" and "mostly" useful. Sixteen (16%) percent of the curricula were rated "slightly" to "moderately" useful, and 11% were rated "not useful" to "slightly useful". None of the curricula received an overall average rating of "very useful", although 8, or 42%, received an average rating approaching "very useful" from teachers at various grade levels. These findings suggest that although some of the existing marine curricula appear to be quite useful to some teachers, there is ample room for curriculum improvement. It seems clear from the comments of numerous respondents and from the usefulness ratings that teachers in Maine prefer marine curricula that address marine concepts and issues relevant to their state. It is also clear that such curricula must meet the needs and be adjusted to the capabilities of teachers and students at various grade levels. Many existing marine curricula do not address concepts and issues relevant to Maine, and when they do, they generally are written at one specific level, thereby expecting the individual teacher to adjust the contents or activities so as to make them applicable to his/her grade level and students. Most teachers do not have the time to do this. What may be needed is a well-integrated marine curriculum guide or package, in which the contents and activities are adjusted, modified or varied to reflect the needs and capabilities of teachers, as well as the needs, capabilities and conceptual backgrounds of students at various grade levels. We already have significant data on the likely conceptual backgrounds, missing concepts and misconceptions of Maine students regarding marine-related concepts and issues (Brody and Koch, 1985).This information can serve as a starting point for the construction of a marine curriculum in which new concepts are meaningfully linked to relevant concepts students already possess, and in which misconceptions are explicitly addressed so as to reduce their frequency. Further input from teachers will be needed about the content and types of activities they might wish to be included in an integrated, up-to-date Maine and student-centered marine curriculum.

In her study of the status of marine education in California public schools, Thornley (1981) listed several marine education needs that are shown by our survey to be just as applicable to the state of Maine as they are to California. These needs are: (1) coordination of marine education activities through resource guides, newsletters and resource centers, and (2) development and distribution of updated marine instructional materials and curriculum guides. In addition, our survey suggests a need for more vigorous efforts by marine educators to provide practical assistance to Maine teachers, particularly to those teaching in inland areas of the state. Finally, more information and additional research is needed on (1) the

proportions of teachers at a given grade level who teach and do not teach marine-related topics, and the reasons for this, (2) the actual number of students who receive some form of marine education at each grade level and in each county, (3) the reasons why teachers in certain counties or school systems devote more time to marine education topics than teachers in other counties and school systems, (4) the factors and characteristics that make some marine education resources and curricula more appealing and useful to teachers than others, and (5) the kinds of marine-related concepts, issues and activities teachers in Maine at various grade levels deem important and significant for their students to learn, and why.

The ultimate goal for marine education in Maine ought to be the inclusion of critical marine education and conservation topics in the general curriculum of every school system. This goal is neither unrealistic nor impractical in view of the importance of the marine environment and its resources not only for the preservation of Maine's unique culture and socio-economic structure, but also for the preservation and continued well-being of a planet whose oceans have enriched and sustained the lives and cultures of so many of its human inhabitants.

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Appendix 1

SURVEY INSTRUMENT

	Not Useful				Very Useful
1. Northern New England Marine Education Project:					
What are the ABC's of marine education?	1	2	3	4	5
Have you been to the shore before?	1	2	3	4	5
What is our maritime heritage?	1	2	3	4	5
How do people use lighthouses and navigational charts?	1	2	3	4	5
What adventures can you have in wetlands, lakes, ponds and puddles?	1	2	3	4	5
Is our food future in the sea?	1	2	3	4	5
Do you know our marine fishes?	1	2	3	4	5
Do you know our marine algae?	1	2	3	4	5
Whale Multidisciplinary studies	1	2	3	4	5
What is our coastal future?	1	2	3	4	5
2. Department of Marine Resources Marine Education Activities	1	2	3	4	5
3. College of Atlantic (Whale Education Program)	1	2	3	4	5
4. Project COAST (U of Delaware)	1	2	3	4	5
5. Maine Science Studies Curriculum	1	2	3	4	5
6. Coastal Problems and Resource Management (Hawaii)	1	2	3	4	5
7. Project Oceanology (Groton, Connecticut)	1	2	3	4	5
8. High School Marine Studies Curriculum (Hawaii)	1	2	3	4	5
9. Floating Laboratory Manual (U of New Hampshire)	1	2	3	4	5
10. Voyage of the MiMi (Bank Street School)	1	2	3	4	5
11. Other _____	1	2	3	4	5
_____	1	2	3	4	5

(8) What town do you teach in? _____

(9) At what grade levels do you use marine education activities?

K 1 2 3 4 5 6 7 8 9 10 11 12

DIRECTIONS: PLEASE CIRCLE THE NUMBER OF THE APPROPRIATE RESPONSE.

(1) What county do you teach in?

1. Aroostook
2. Somerset
3. Piscataquis
4. Penobscot
5. Washington
6. Hancock
7. Franklin
8. Oxford
9. Waldo
10. Kennebec
11. Lincoln
12. Knox
13. Sagadohoc
14. Cumberland
15. York
16. Androscoggin

(2) How many miles from the coast is your school located?

1. 0 - 10
2. 11 - 50
3. 51 - 100
4. >100

(3) What is the total time you spend with your classes doing marine education activities?

1. zero
2. one period
3. 1/2 day (3 periods)
4. 1 day (5 - 6 periods)
5. one week (5 days)
6. one month (20 days)
7. one semester
8. one year

(4) How many students in your classes are involved in marine education activities during the school year?

1. 0
2. 1 - 5
3. 6 - 10
4. 11 - 25
5. 26 - 50
6. 51 - 100
7. 101 - 150
8. 151 - 200

(5) In what subject areas do you use marine education activities?

1. Social Studies
2. Math
3. Biology
4. Chemistry
5. Physics
6. Earth Science
7. Home Economics
8. Industrial Arts
9. Language Arts
10. English
11. Art
12. Other

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(6) What topics do you teach within the marine education activities?

1. sharks
2. whales
3. lobsters
4. seaweeds
5. maritime heritage
6. coastal issues
7. marine geology
8. fish and fishing
9. salt marshes
10. ships and navigation
11. seafood cooking
12. marine art
13. chemical oceanography
14. physical oceanography
15. marine biology
16. marine ecology
17. estuaries
18. aquaculture
19. The Gulf of Maine
20. Georges Bank
21. other _____

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(7) Which of the following marine curriculum materials do you use for marine education activities? Please rate them on the scale to the right.

Appendix 2: Sample of comments made by respondents on a variety of survey issues. Numbers in parentheses are grade levels taught by respondent who made the comment.

A. General Comments about the Survey and Use of Maine Education

"As a high school math teacher, I do not do marine education."

"Our school system is in the process of revising its science program. I use marine education on a very superficial level; however, this may change after our committee has revised the science program." (1)

"I teach elementary music and do not use marine education, per se."

"In speech class, marine education topics can and often do pop up in speeches." (9-12)

"I teach mathematics only and don't believe this questionnaire should be filled out by me but by a science teacher."

"I don't do anything with marine education! I teach math and computer science."

"If this is a random survey, that explains why I (a high school French teacher) received it. But what good will my answers do you?"

"The next time you do a survey you should be more specific with your sampling. I teach foreign languages and with the exception of general environmental issues I do not touch the technical topics of marine education. So, foreign language teachers don't really make good members of your survey population, neither do they give you any valuable insights."

"I teach health and home economics--neither course contains marine education activities."

"I'm a geometry teacher. Some science classes here do teach some of this material."

"Why have you sent this to an English literature teacher? How much did this cost the state?!!"

"We don't cover marine education in 4th grade here--but once children reach 6th grade, it's part of the curriculum." (4)

"Although I do a minimal amount with marine education, I know most teachers do even less. Good luck!" (2)

"I am a music teacher so any marine education I would do would be through song."

"Marine education is an on-going process in my class, but not discussed on a daily basis." (5)

"I am a math teacher. Our science department covers marine education very nicely; math only contributes with calculations, graphs and interpretations." (6)

Appendix 2 (A) continued

"I am an English teacher and do not at present use marine education topics but may do so in the future, now that you have introduced the topic. I can see potential writing activities."

"We deal with marine issues as they are introduced in our Reading units. We also touch on it as a job of some of our parents when we talk about community and jobs." (3)

"I teach U.S. History to grade 11. This year I am also teaching world geography to grades 9-12. I have used a little maritime heritage, but it is very minimal."

"Your survey came to an English teacher. On the secondary level we are departmentalized. The most I might do on the ocean would be discussing the novel, Moby Dick."

"I am an English teacher. I certainly support the growth of marine education, but I do not use it in English except when we discuss whales and whaling in regard to Moby Dick."

"I do not teach marine education activities as I am a physical education-health instructor. I might mention something in this line during health classes, but do not teach a unit on marine education."

"I teach business education. This is not applicable."

"Most of this does not apply as I teach reading and literature. I could easily include marine education in my curriculum if I had a proper reading list."

"I teach math and social studies so I don't use marine education materials. We do cover the ocean as part of this earth in social studies, but not in much depth." (6)

B. Comments about Marine Curricula on Survey Instrument and about other Marine Education Resources

"I am not at all acquainted with these materials." (7)

"I am not familiar with these curricula. I spend about 4 weeks doing a unit on marine education but not every year. I teach it on my own initiative every other year (not part of formal science curriculum)." (3,4)

"I do not use any of these curricula. I have designed my own lessons to incorporate the material." (2)

"In our school, we have Sea Week in the spring during which all subjects revolve around marine education. We have many speakers, community involvement and our own curriculum." (3)

"There is currently no marine education program here. Our new science texts have an oceanography unit which I plan to use. I am very interested in planning a multidiscipline approach and plan to do so." (3,4,5)

"I love the College of the Atlantic whale program but our school won't pay for it." (1)

"While I am familiar with all of these curricula, I have only used those which I have circled. It is not always possible for me to get to the Univ. of Maine to use these materials and my school owns only a few of them... Curricula 4-10 are good, but not always appropriate for the coast of Maine." (8,12)

"I make books on the subject of the sea available to my pupils for a longer time than our science book coverage involves. I have a shell collection which they have to try to identify." (3)

"I would very much like to teach marine education. I am very interested in it...but, no resources." (1)

"Some of these materials sound very useful." (1)

"I tried to purchase "Have you been to the shore before" but it was unavailable." (6)

"I use a marine education unit which I developed while attending UMO CED courses. My unit includes many books and film strips." (1)

"I use only my science book and a visit from Mr. and Mrs. Fish." (2)

"I use filmstrips, worksheets and maps to prepare students for a boat cruise from Boothbay Harbor. We discuss marine life and coastal heritage and history to prepare as to what they will see. I also use marine topics in creative writing." (6)

"I don't know about any of these. I prepare my own materials." (8)

"I have written my own materials using a variety of sources. We take a 3-day trip to the coast to investigate the ecology of the intertidal zone. It is the major educational activity of our college prep. biology program." (10)

Appendix 2

C. Comments dealing with Requests for more Information

"I am not familiar with any of the above programs, but would like further information, if possible." (6)

"These sound most helpful. Could you please send addresses where I could purchase materials?" (2)

"I use films, speakers, anything I can get. I'll take suggestions." (7)

"I use none of these curricula, but would like to know how to get them!" (K,1)

"If any of these curriculum materials are available and appropriate for grade 7 students, I would appreciate more information." (7)

"I don't know any of these materials, but would be interested in materials for 2nd grade." (2)

"I was not aware of their availability. Would like info. on all of these for my class." (4)

"I have none of these materials. How could I get those listed under #1? Our 6th grade textbook has a short section in one chapter that mentions the marine habitat briefly." (6)

"How about sending a sample collection of these so I can know what I could use?" (10,11)

"I would like to do more with marine education. Please send me any elementary information." (3)

"I am familiar with the NNEMEP materials and would love to have a full set of these! How can I get them? I am also a cubmaster with BSA and would love to get my pack involved." (7,8)

Appendix 3. Map of Maine with outline of counties. Coastal areas are indicated by shading.